2

[0014] FIG. **5** is a graph showing a signal, maxima and minima according to one embodiment;

[0015] FIG. **6** is a graph showing a signal, upper envelope, lower envelope and mean function according to one embodiment;

[0016] FIG. **7** is a graph showing an iteration of a signal from h_i to h_{i+1} through sifting method according to one embodiment;

[0017] FIG. **8** is a graph showing first IMF and residual signals using 64 iterations of the sifting method according to one embodiment;

[0018] FIG. **9** is a graph showing the results of the sifting method, h_{1k} indicates the first IMF component and the kth iteration through the sifting method;

[0019] FIG. **10** is a graph showing the fifth IMF and original signal according to one embodiment;

[0020] FIG. **11** is a graph showing signal maxima and minima;

[0021] FIG. **12** is a graph showing a signal, upper envelope, lower envelope and mean function;

[0022] FIG. **13** is a graph showing an iteration of signal from h_i to h_{i+1} through sifting method;

[0023] FIG. **14** is a graph showing first IMF and residual signals using 64 iterations of the sifting method;

[0024] FIG. **15** is a block diagram of the filter-based EMD method implemented as a real-time process;

[0025] FIG. **16** is a block diagram of the filter-based EMD method using a low pass filter implemented as a real-time process;

[0026] FIG. **17** is a block diagram showing a post-processing high-pass filter EMD;

[0027] FIG. **18** is a block diagram showing a post-processing high-pass filter EMD;

[0028] FIG. **19** is a Cauchy criterion as a function of iteration number for the three sinusoid signal IMF_0;

[0029] FIG. **20** is a Cauchy criterion as a function of iteration number for the three sinusoid signal IMF_4;

[0030] FIG. **21** is a graph showing the number of extreme values as a function of iteration number for the three sinusoid signal IMF_0;

[0031] FIG. **22** is a Cauchy criterion as a function of iteration number for the acoustic signal IMF_0;

[0032] FIG. **23** is a graph showing the number of extreme values as a function of iteration number for the acoustic IMF_0;

[0033] FIG. **24** is a graph showing the IMFo of the three sinusoid signal for the four EMD methods; and

[0034] FIG. **25** is a graph showing the IMFo of the acoustic signal for the four EMD methods.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0035] The systems and methods include systems and methods for identifying phonemes and replacing the phoneme with something that may be distinguished by a user which may include, but is not limited to, one or more of the following: audio signal, and/or vibratory signal. The system and methods include transmitting and/or broadcasting the replacement signal.

[0036] In various embodiments, the system and methods may include at least one microphone, at least one speaker and at least one processor (See FIG. **1**). The processor, in some embodiments, includes instructions for a machine which implements methods/instructions including one or

more for processing audio signals. In various embodiments, the processor processes at least one audio signal and transmits the processed signal.

[0037] Referring now to FIG. **2**, in some embodiments, the methods/instructions may include at least two components, a learning method and a broadcast method. The learning method may monitor the audio signal and the background noise. It may provide feedback to the broadcast method to enhance the performance of the traditional filtering in the system. In addition, it may provide information which may be used by classification methods to enhance the accuracy of phoneme identification. Finally, the learning method may assist the software which puts together the signal to be played to the user, ensuring it flows smoothly and minimizes distracting artifacts.

[0038] In some embodiments, the processor includes instructions for a machine which, when implemented, causes the processor to implement one or more of the following methods. These may include where the method identifies phonemes and includes phoneme replacement. Also, these may include where the system includes a learning method (s) which may monitor the audio signals and background noise. In some embodiments, the system may provide information which may be used by classification methods to enhance the accuracy of phoneme identification. In some embodiments, the phoneme identification methods may assist the methods/instructions which processes the audio signals and sends the audio signals to the at least one speaker.

[0039] In some embodiments, and referring now to FIG. **3**, the processor receives an audio signal from a speaker and performs initial processing. The processing may include conventional filtering intended to remove noise and, in some embodiments, remove audio features that may disrupt later steps. The audio stream, in some embodiments, may be fed to both a phoneme identification method and a phoneme replacement method.

[0040] In some embodiments, the Hilbert-Huang transform ("HHT") may be used as part of the phoneme identification method. The whole sub-function identifies the time slot occupied by a phoneme and the particular phoneme being uttered. It passes these pieces of information to the phoneme replacement method.

[0041] In some embodiments, the phoneme replacement method determines whether the current phoneme in the audio stream needs to be replaced. In some embodiments, the method includes pulling or receiving the replacement sound from a table and determining a way to smoothly incorporate this sound into the audio. The new signal is then passed on to a standard method for playing the audio through the attached speaker.

[0042] As FIG. **3** shows, in some embodiments, there is two-way communication between the broadcast method's audio pre-processor, phoneme identification method, and phoneme replacement method on one side and the learning method on the other. In some embodiments, knowledge of the audio stream history beyond the scope of the broadcast method may be used by each of these sub-functions. The pre-processor filter settings may benefit from in depth characterization of the noise background. In some embodiments, the phoneme identification method may use an analysis of likely next phonemes to improve selection accuracy. Similarly, in some embodiments, the phoneme replacement